EXPLORE SCIENCE

SBIR INNOVATION OPPORTUNITY CONFERENCE

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NASA Headquarters
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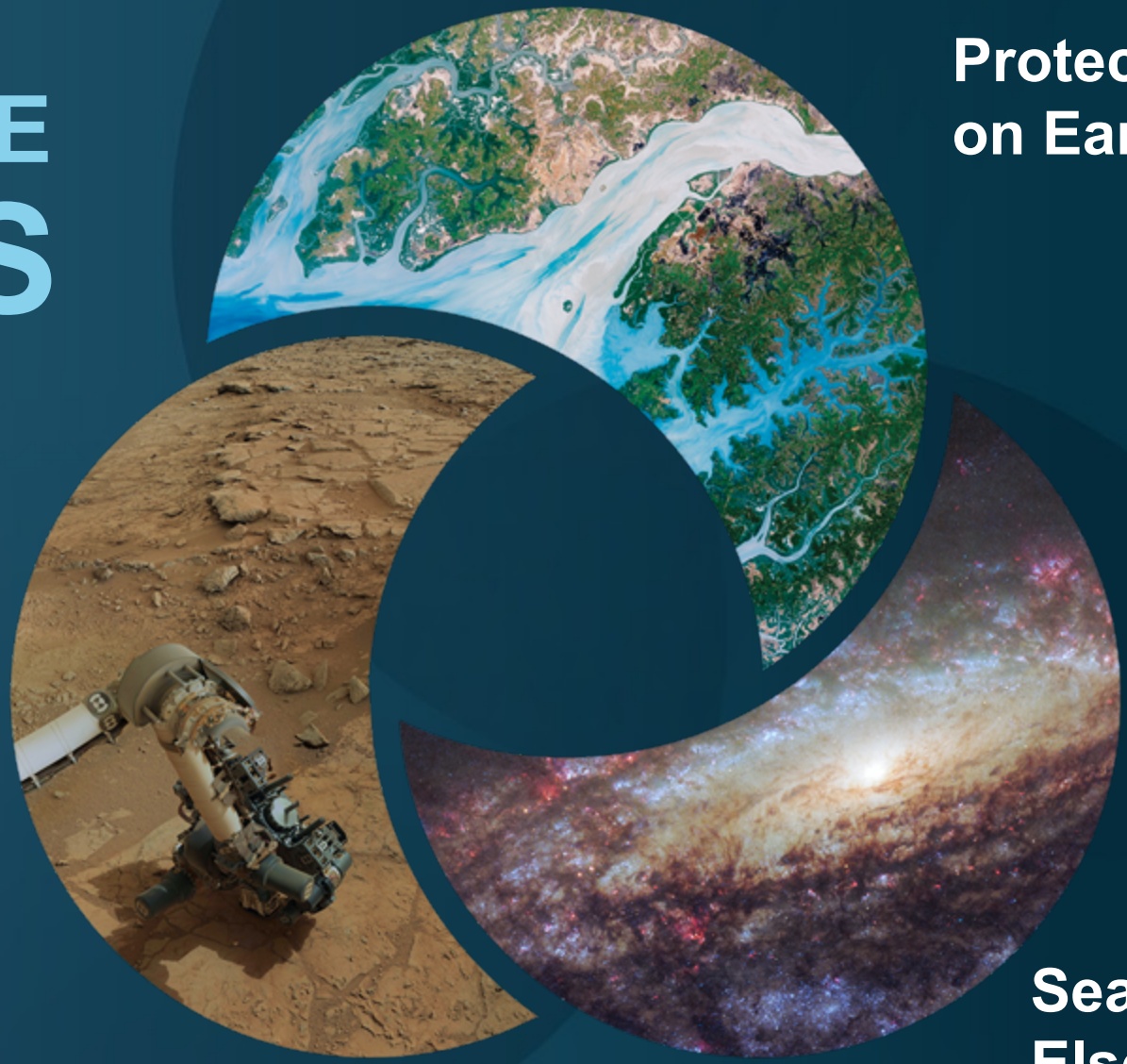
KEY SCIENCE THEMES



Protect & Improve Life on Earth & in Space

Discover Secrets of the Universe

Search for Life Elsewhere

Overview of NASA Science

Active SMD Technology Programs

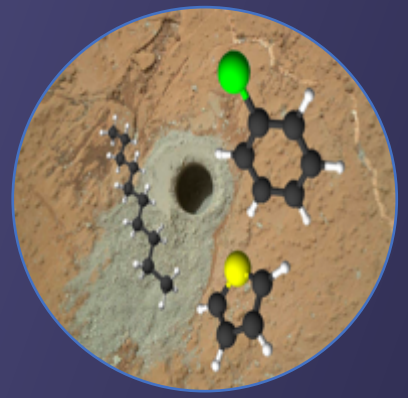
Total FY19 SMD Technology Investments: $509M annually

SMD solicitations driven by science priorities from the National Academies

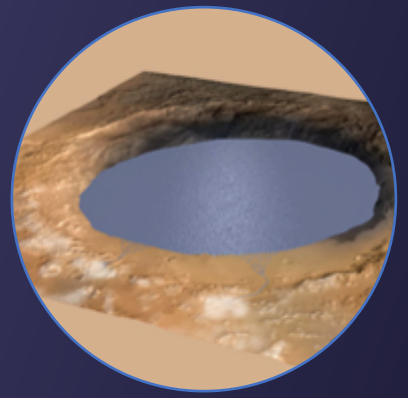
Heliophysics	Earth Science		Planetary Science		Astrophysics	Crosscutting
Heliophysics Flight Opportunities for Research & Technology (HFORT)	Instrument Incubator (IIP)	Sustainable Land Imaging Technology (SLIT)	Planetary Instrument Concepts for the Advancement of Solar System Observations (PICASSO)	Scientific Exploration Subsurface Access Mechanism for Europa (SESAME)	Strategic Astrophysics Technology (SAT)	Applied Information Systems Research (AISRP)
Heliophysics Technology and Instrument Development (HTIDS)	Advanced Component Technology (ACT)	Decadal Survey Incubation (DSI)	Maturation of Instruments for Solar System Exploration (MATISSE)	Lunar Surface Instrument and Technology Payloads (LSITP)	Astrophysics Research and Analysis (APRA)	
	Adv Info Systems Technology (AIST)	In-Space Validation of Earth Science Technologies (InVEST)	Development of Advanced Lunar Instruments (DALI)	Astrodynamics - Tools (ADYN)	Nancy Grace Roman Technology Fellows (RTF)	
			Concepts for Ocean Worlds Life Detection Technology (CLDTECH)	High Operating Temperature Technology (HOTTECH)		
			Instrument Concepts for Europa Exploration (ICEE)	Planetary Science & Technology Through Analog Research (PSTAR)		

Some Science Discoveries by the Curiosity Rover

Mars Organics

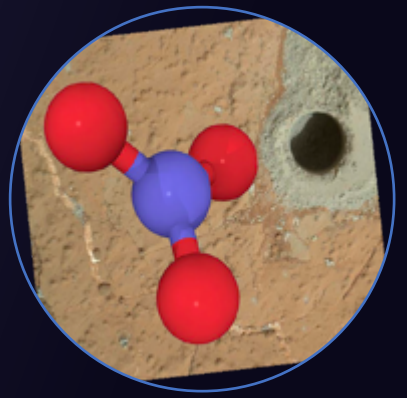


Water in the Hesperian – and its loss



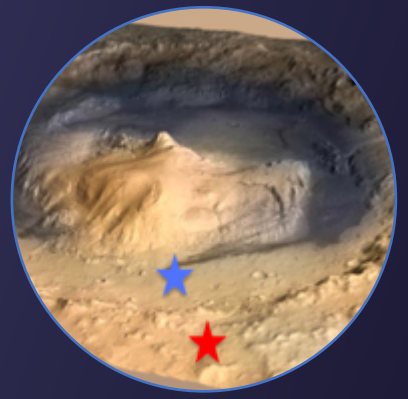
Atmosphere Loss

Detection of fixed Nitrogen

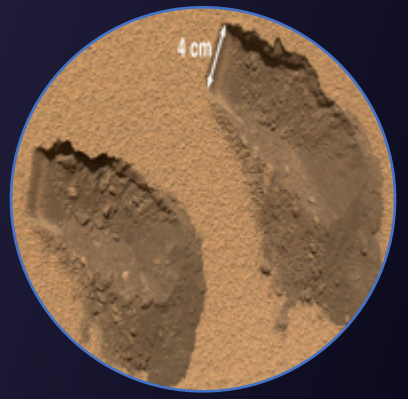


Persistence of aqueous activity

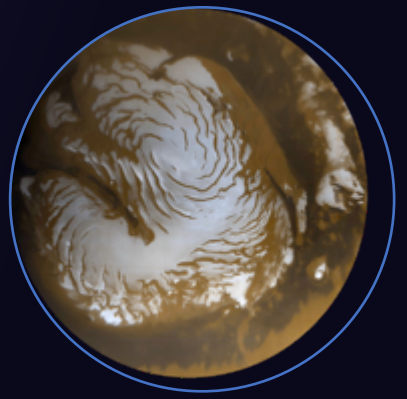
Methane Variability



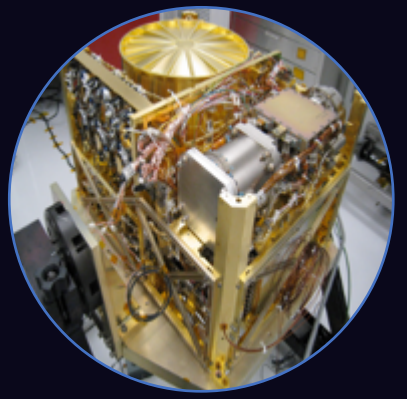
Gale Crater Age and Rock Exposure Age



Chlorine and Sulfur Compounds are Everywhere



Seasonal changes in Atmospheric Composition



Ancient hydrothermal system with right ingredients for life

SBIR Success Story: CREARE

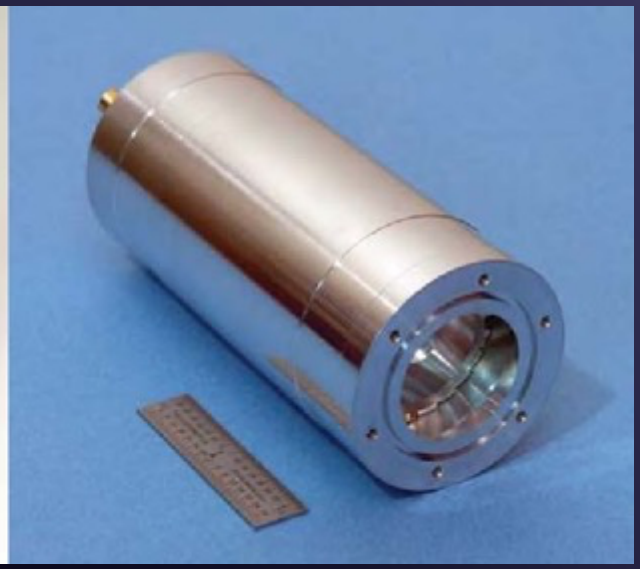
Post-PHASE II SUCCESS

$6 million in contracts from NASA to build life-test and flight units for SAM instrument on Curiosity Rover

SNAPSHOT

Creare created a miniature space-qualified turbo molecular wide-range pump (WRP).

Smallest Turbomolecular Drag Pump


Space-Qualified Wide Range Pump

WIDE RANGE TURBO-MOLECULAR SPACE-QUALIFIED PUMP

Creare, Hanover, New Hampshire

Innovation

Creare and NASA Goddard Space Flight Center developed and space qualified two wire range pumps (WRPs) utilized in the Sample Analysis at Mars (SAM) instrument in the Curiosity Rover. The pumps have operated for more than 8 years on Mars, and played a key supporting role in Curiosity discoveries. These pumps provide a low mass, low form factor, and essential turbo molecular pumping function for our science discoveries on Mars.

SBIR Success Story: HoneyBee Robotics

Post-PHASE 2 SUCCESS

> $1M in contracts from NASA to build life-test and flight units for Dust Removal Tool on Curiosity Rover

SNAPSHOT

HoneyBee Robotics innovated multiple drills, tools, sampling mechanisms for MER, Curiosity, and Perseverance Rovers at Mars and the Viper Rover to the Moon.

Dust Removal Tool

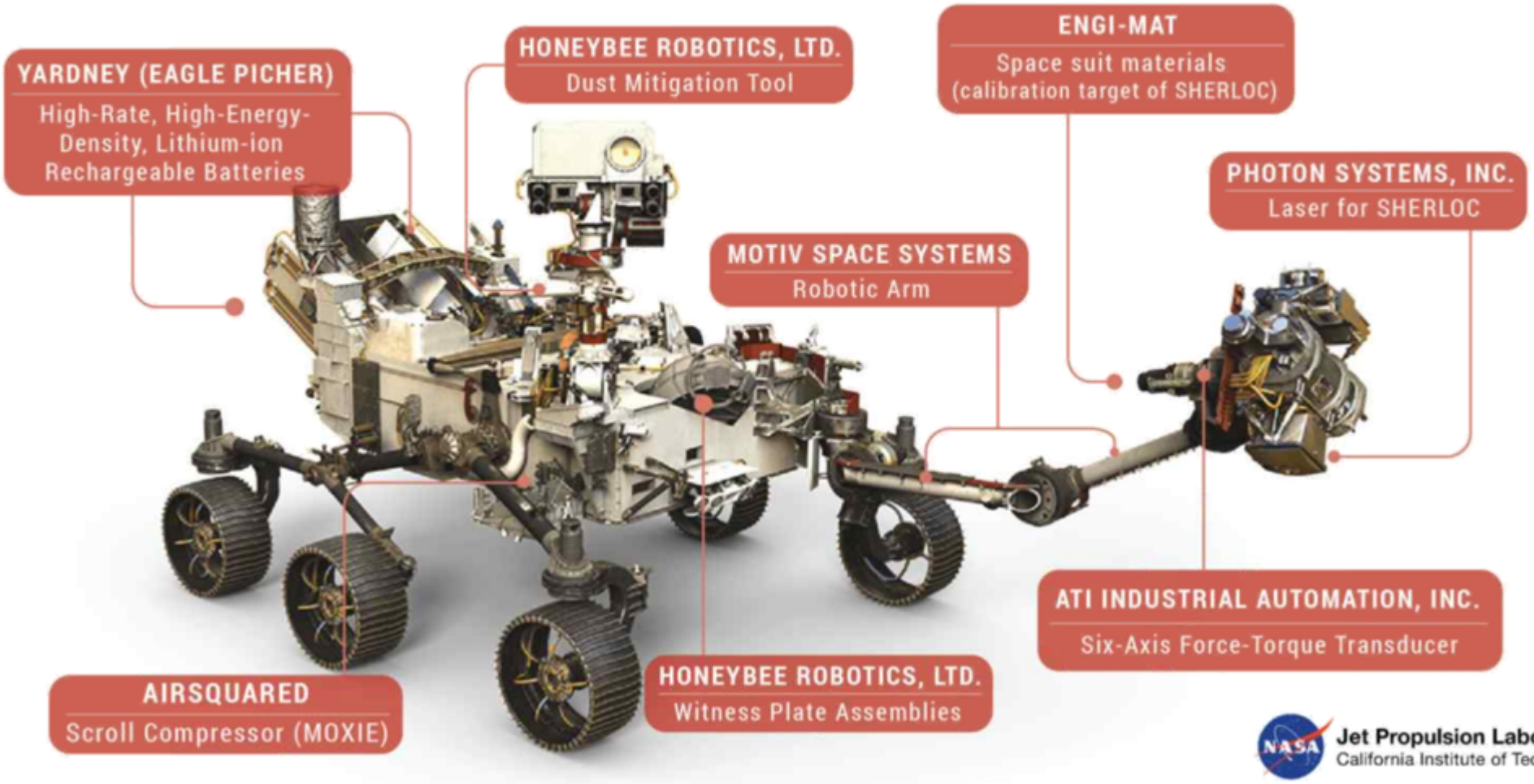
Honeybee Robotics, New York

Innovation

Since the 1990s, Honeybee Robotics won SBIR grants to create tools for Mars missions. The Dust Removal Tool (DRT) flew on the Curiosity Rover and traces its heritage from the development of the Rock Abrasion Tool (RAT) and the Mini-Corer, both funded by SBIR. It is because of the early successes of the mini-corer the RAT that Honeybee Robotics has continued to provide other key technologies necessary for our off-world mechanisms including the SMS.

"The SBIR program was absolutely vital to early days of Honeybee Robotics"
– Steve Gorevan, Co-founder HoneyBee Robotics

SBIR TECH ON-BOARD MARS 2020 PERSEVERANCE ROVER



Jet Propulsion Laboratory
California Institute of Technology

Entrepreneur's Challenge: Program Goals

Goal: Provide early-stage companies with an "on ramp" to SMD technology programs

Approach: Provide a $100K prize for those with novel ideas in three targeted areas:

- **Quantum sensing** to support high precision measurements of gravity, magnetic fields, dark energy, and other measurements to support NASA science.
- **Novel, high-resolution spectrometers** that are low size, weight, and power for Earth observation and for life detection on planetary surfaces.
- **Physics-based transfer learning and artificial intelligence** that can be used for
  - training on the ground with historical data, and using physical models to inform the transfer learning process before the algorithms are run onboard on 1) autonomous spacecraft/surface rovers and 2) Earth observation and disaster management systems,
  - the processing of astronomical data, or,
  - developing optimal data or developing optimal diagnostics and algorithms for interpreting spectral and temporal datasets.
- **NASA's SBIR program will offer support to the companies in preparing a Phase I proposal. Teams will be invited to the SBIR Innovation Opportunity Conference October 22**

Mentoring / Next Steps

Next Steps

- Mentors have been assigned to each company to assist in linking their capabilities to a NASA problem
- The companies will make second pitch at the Innovation Opportunity Conference for an $80K prize
- NASA's SBIR program will offer support to the companies in preparing a Phase 1 proposal
- Mentors will also provide advice for preparing a ROSES proposals

Company	Topic Area
Energi	Machine Learning
Qunnect	Machine Learning
Cognitive Space	Machine Learning
Eric Eaton	Machine Learning
Mobilion	Mass Spectrometry
Trace Matters	Mass Spectrometry
Guardion	Mass Spectrometry
Cold Quanta	Quantum Sensors
Tarsier	Quantum Sensors
Aperio	Quantum Sensors

Sample Project: Artificial Intelligence Topic

Qunnect

Self-Tuning Optical Filtering for Autonomous Spacecraft

Artificial Intelligence

Company Status
- Founded in 2017
- 2-10 employees

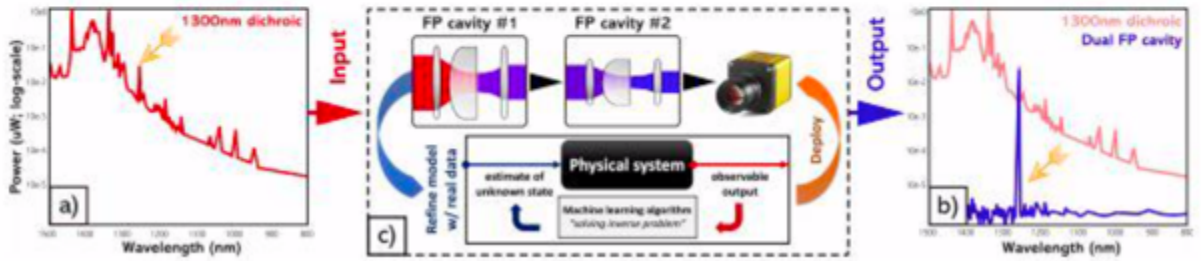
Funding
- SBIR (2019-2020) - $1.75M

Stonybrook, NY quconn.com

Product
- Qunnect is developing a <50MHz-bandwidth self-tuning optical filter cavity hardware module using physics-based transfer learning and AI for use in autonomous spacecraft and instrumentation.
- Deployed in a fielded device, this algorithm architecture will allow for alerting of apparatus failure, automating diagnostics, and planning maintenance based on equipment conditions - drastically improving the signal to noise ratio (SNR) and operational uptime of cavity-enhanced photonics

Unique Selling Proposition
- By including feedback of the cavity mode and control of its tuning vectors, a reinforcement learning algorithm maximizes the quality of the cavity output, allowing algorithms to learn the optimal path towards perfect alignment.
- Qunnect's solution will assess the output beam quality through images captured at the cavity's output and processed by a convolutional neural network (CNN) to measure the degree of misalignment (quantifying the similarity of the beam profile to a Gaussian zeroth-order mode).
- The apparatus will function at a sub-nm filtering bandwidth, with high > 80% throughput, and will be tunable over NIR-band wavelengths of 650−1550nm with high out-of-band blocking (i.e. > 45dB extinction).

Showcase



Example of a cavity filtering apparatus and ML workflow.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